CLAIMS:

1. A simulation system for generating a predicted performance for fabricated parts comprising:

a rheological degradation database for storing a plurality of rheological degradation data for associated materials;

a mechanical degradation database for storing a plurality of mechanical degradation data for associated materials;

a computer coupled to said rheological degradation database and said mechanical degradation database for computing part performance predictions for a respective material with a predetermined geometry under predetermined processing conditions, partially based on said rheological degradation data and said mechanical degradation data.

2. A simulation system in accordance with claim 1, wherein said materials are selected from the group consisting of polymer, metal and ceramic.

3. A simulation system in accordance with claim 1, wherein said material is silicone.

4. A simulation system in accordance with claim 1, wherein said material is magnesium.

5. A simulation system in accordance with claim 1, wherein a part geometry of an object to be fabricated is imported into said computer.

6. A simulation system in accordance with claim 1, wherein said process conditions include filling time, mold temperature and melt temperature.

7. A simulation system in accordance with claim 5, wherein importing a model entails generating a CAD part model of a three-dimensional object and discretizing the part model.

8. A simulation system in accordance with claim 7, wherein said CAD design program is Unigraphics™ or ProEngineer™

9. A simulation system in accordance with claim 7, wherein the three-dimensional model is discretized by enveloping the model with a finite element mesh.

10. A simulation system in accordance with claim 9, wherein a graphics software capable of decomposing a 3-D surface into a mesh of triangular or otherwise shaped elements, or facets, is used.

11. A simulation system in accordance with claim 10, wherein said graphics software is Patran™, I-DEAS™, or Hypermesh™.

12. A simulation system in accordance with claim 1, wherein a process window is generated by said computer using said mechanical degradation data and said rheological degradation data.

13. A simulation system in accordance with claim 12, wherein a thinwall prediction is made

14. A simulation system in accordance with claim 13, wherein said computer 16 compares said thin-wall prediction to said process window.

15. A simulation system in accordance with claim 14, wherein if the prediction falls within said process window, the simulation is complete and the part design is acceptable.

16. A simulation system in accordance with claim 14, wherein if said prediction falls outside of said process window said part design or said processing conditions are unacceptable and said inputs need modification.

17. A simulation system in accordance with claim 13, wherein said thinwall prediction comprises a first filling step of size Δt_f and a temperature step of size Δt_T.

18. A simulation system in accordance with claim 17, wherein for conductive and convective terms, said time step size, Δt, is defined as follows:

$$\Delta t \leq \frac{1}{\frac{2\alpha}{(\Delta z)^2} + \frac{v_x}{\Delta x} + \frac{v_y}{\Delta y}}$$

where

α is the thermal diffusivity

Δz is the mesh size in the thickness (or z) direction

v_x is the velocity in the x flow direction

Δx is the mesh size in the x flow direction

v_y is the velocity in the y flow direction

Δy is the mesh size in the y flow direction

ρ is the density

C_p is the specific heat

A, B, C are the coefficients of the Power Law viscosity model

$\dot{\gamma}$ is the shear rate and

T is the resin temperature.

19. A simulation system in accordance with claim 17, wherein for a viscous heating term, said time step is represented as follows:

$$\Delta t \leq \frac{\rho C_P}{\left| A C \dot{\gamma}^{B+2} e^{CT} \right|}$$

where,

α is the thermal diffusivity

Δz is the mesh size in the thickness (or z) direction

v_x is the velocity in the x flow direction

Δx is the mesh size in the x flow direction

v_y is the velocity in the y flow direction

Δy is the mesh size in the y flow direction

ρ is the density

C_p is the specific heat

A, B, C are the coefficients of the Power Law viscosity model

$\dot{\gamma}$ is the shear rate and

T is the resin temperature.

20. A simulation system in accordance with claim 17, wherein a temperature is calculated and a pressure is calculated.

21. A simulation system in accordance with claim 20, wherein a convergence of said pressure is monitored.

22. A simulation system in accordance with claim 21, wherein if said pressure has converged, the system monitors for temperature convergence.

23. A simulation system in accordance with claim 20, wherein a convergence of said temperature is monitored.

24. A simulation system in accordance with claim 23, wherein if the temperature has converged, the system monitors whether all of the temperature steps have been solved.

25. A simulation system in accordance with claim 24, wherein if all of the temperature steps have not been solved, the next temperature step is processed.

26. A simulation system in accordance with claim 25, wherein if all of the temperature steps have been solved, the system monitors whether the mold has been filled.

27. A simulation system in accordance with claim 26, wherein if the mold has not been filled, the next filling step is processed.

28. A simulation system in accordance with claim 26, wherein if the mold is full, the process continues to post-processing where results are written and saved to said computer.

29. A simulation system in accordance with claim 1, wherein said rheological degradation database is propagated with empirical rheological degradation data for said selected material.

30. A simulation system in accordance with claim 29, wherein a portion of said rheological degradation database is propagated by:

selecting a material to test;

measuring the viscosity of said selected material

pre-shearing portions of said material at various shear rates;

measuring the viscosity of said pre-sheared material

calculating the viscosity ratio between said pre-sheared material and said material to detect a pre-shear effect on said material.

31. A simulation system in accordance with claim 29, wherein a portion of said rheological database is generated by:

selecting a material to test;

measuring the viscosity of said selected material

heating portions of said material at various temperatures;

measuring the viscosity of said heated portions;

calculating the viscosity ratio between said heated material and said material to detect a temperature effect on said material.

32. A simulation system in accordance with claim 1, wherein said mechanical degradation database is propagated with empirical mechanical degradation data for said selected material.

33. A simulation system in accordance with claim 31, wherein a portion of said mechanical degradation database is generated by:

selecting a material to test;

computing the local shear and temperature behavior of said selected material

selecting test conditions based on behavior information to cover a broad test range;

making sample parts under the selected test conditions

performing impact tests on said sample parts; and

performing tensile tests on said sample parts.

34. A method for generating a predicated performance for a fabricated part comprising:

importing a model;

inputting a fabrication material;

inputting processing conditions;

importing rheological degradation data for said selected material;

importing mechanical degradation data for said selected material;

generating a process window;

generating a thinwall prediction; and

comparing said thinwall prediction to said process window.

35. A method for generating a predicated performance, in accordance with claim 34, wherein said step of importing a model comprises:

generating a part model; and

discretizing said part model.

36. A method for generating a predicated performance, in accordance with claim 34, wherein said step of inputting fabrication material includes:

inputting a fill time;

inputting a mold temperature; and

inputting a resin melt temperature.

37. A method for generating a predicated performance, in accordance with claim 34, wherein said step of inputting a fabrication material is selected from the group consisting of polymer, metal and ceramic.

38. A method for generating a predicated performance, in accordance with claim 34, wherein said step of importing rheological degradation data for said selected material comprises:

importing said database rheological degradation data from a rheological degradation database.

39. A method for generating a predicated performance, in accordance with claim 38, wherein said rheological database is generated by:

selecting a material to test;

measuring the viscosity of said selected material

heating portions of said material at various temperatures;

measuring the viscosity of said heated portions;

calculating the viscosity ratio between said heated material and said material to detect a temperature effect on said material.

40. A method for generating a predicated performance, in accordance with claim 38, wherein said rheological database is generated by:

selecting a material to test;

measuring the viscosity of said selected material

heating portions of said material at various temperatures;

measuring the viscosity of said heated portions;

calculating the viscosity ratio between said heated material and said material to detect a temperature effect on said material.

41. A method for generating a predicated performance, in accordance with claim 34, wherein said step of importing mechanical degradation data for said selected material comprises:

importing said mechanical degradation data from a mechanical degradation database.

42. A method for generating a predicated performance, in accordance with claim 41, wherein said mechanical database is generated by:

selecting a material to test;

computing the local shear and temperature behavior of said selected material

selecting test conditions based on behavior information to cover a broad test range;

making sample parts under the selected test conditions

performing impact tests on said sample parts; and

performing tensile tests on said sample parts.

43. Computer-readable media tangibly embodying a program of instructions executable by a computer to perform a method of generating a predicated performance for a fabricated part, the method comprising:

importing a model;

inputting a fabrication material;

inputting processing conditions;

importing rheological degradation data for said selected material;

importing mechanical degradation data for said selected material;

generating a process window;

generating a thinwall prediction; and

comparing said thinwall prediction to said process window.

44. Computer-readable media tangibly embodying a program of instructions in accordance with claim 42, wherein said media comprise at least one of a RAM, A ROM, a disk, a CDROM, a DVDROM, an ASIC and a PROM.

45. A method of generating a predicated performance for a fabricated part, the method comprising:

means for importing a model;

means for inputting a fabrication material;

means for inputting processing conditions;

means for importing rheological degradation data for said selected material;

means for importing mechanical degradation data for said selected material;

means for generating a process window;

means for generating a thinwall prediction; and

means for comparing said thinwall prediction to said process window.